

Collaborative Research: Geometric and Algorithmic Techniques for Design and Verification of Hybrid Control Systems

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Derandomizing PRMs. In the realm of Ideas, Branicky and LaValle have de-randomized probabilistic roadmap methods (PRMs) using quasi-random point sets [3]. The resulting algorithms perform as well or better in practice and give rise to new theoretical results characterizing the complexity of roadmap methods.

Hybrid Planning Tool. In the area of Tools, we have the following. Using our extensions of RRTs to the case of hybrid systems [2], Branicky and his student Josh Levine have modified LaValle’s Motion Strategy Library (MSL) to create a computational tool for hybrid motion planning [2].

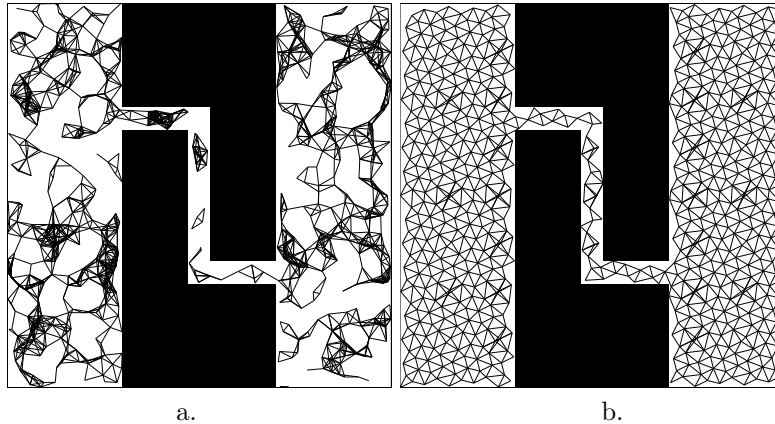


Figure 1: (a) A probabilistic roadmap based on traditional, pseudo-random sampling; (b) a quasi-random version based on Hammersley points. Each uses 1000 samples in the 1×1 space and the same connection radius, 0.05. In (a), note the characteristic clumping of the randomly-chosen nodes and the relatively large areas of free space that contain no samples; it also confirms the well-known fact that narrow passages in C-space are notoriously difficult to find at random. In (b), however, a path through the narrow passage has been found, there is no clumping of points, and every point in the space is fairly close to a vertex.

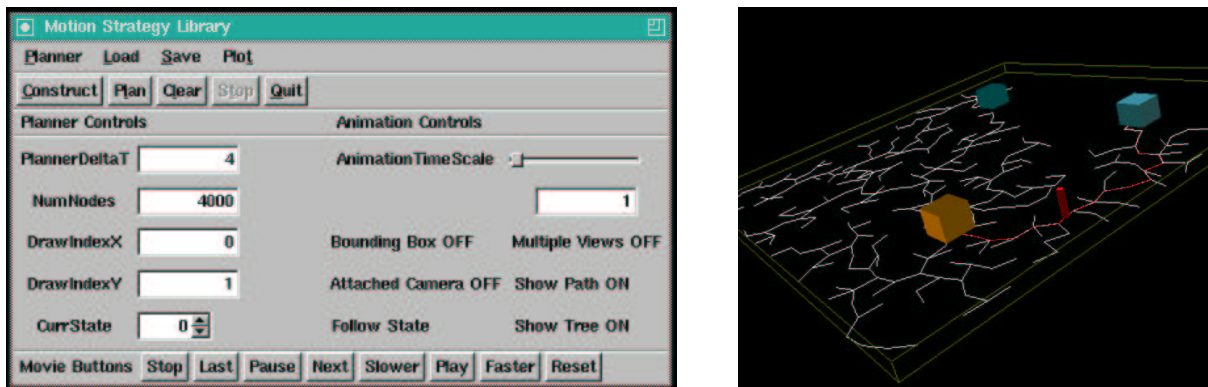


Figure 2: Modified MSL GUI Window (left): note the ability to switch between discrete states (`CurrState`) and follow discrete state changes in path animations. One floor of a Stair-Climber Example (right): the red (dark gray) peg represents the agent, the orange (medium gray) block is a state transition or “down stairs” in which the discrete state q is decremented while the green (light gray) blocks are “up stairs” where q is incremented; the white line segments represent the RRT that has been grown through the system and the overlaid red (gray) segments represent the path determined by the RRT.

- [1] M.S. Branicky, M.M. Curtiss, J. Levine, and S. Morgan. RRTs for nonlinear, discrete, and hybrid planning and control. *Proc. IEEE Conf. Decision and Control*, 2003. Submitted.
- [2] M.S. Branicky and M.M. Curtiss. Nonlinear and hybrid control via RRTs. *Proc. Intl. Symp. Mathematical Theory of Networks and Systems*, South Bend, IN, August 12–16, 2002.
- [3] S.M. LaValle and M. S. Branicky. On the relationship between classical grid search and probabilistic roadmaps. *Proc. Workshop on the Algorithmic Foundations of Robotics*, December 2002.